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THE MOSS-ANIMALS, OR FRESH WATER POLYZOA.

PLATE 3.

BY ALPHEUS HYATT.

Among all the creatures found in our pools and lakes, none are more pleasing to the eye when carefully examined, than the Moss-Animals. These delicate animal-flowers may be found in communities, expanding their shadowy plumes in the darker recesses of our ponds, attached to the under side of submerged sticks, logs and stones.

Figures 1, 2, and 3, in the plate, show three of these communities. In figures 2 and 3 the plumes are expanded, but in figure 1 they are withdrawn, as they always are when the colony is disturbed.

The moss-animals of our fresh waters are, with two exceptions, all members of one group, called Phylactolæmata, or animals with guarded throats; that is, having a little flap outside of the mouth, which guards this aperture. The two exceptions mentioned have not this characteristic, and, therefore, belong to the same division

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as their marine relatives, the Gymnolæmata, or Polyzoa with unguarded throats. Notwithstanding their harsh scientific name, the Phylactolæmata are light, elegant, mossy growths, and, when placed under a low power of the microscope, are even more beautiful than the flowers they resemble.

Their plant-like aspect, however, is a mere semblance, notwithstanding the branching mode of growth. If we examine any one specimen of the genus Fredericella, we speedily learn that the trunk is not a single, straight, solid stem, as in the plants, but made up of a series of minute, dark brown, tubular cells, arranged in a line, with the main branches and shorter twigs, also constructed of cells, arranged in a similar manner. Each cell (fig. 4) is a single animal, and contains the organs and muscles of one being, though so intimately attached to others, and so merged in the general life of the community, that it cannot, strictly speaking, be called an individual. An individual is but one animal, freely following the bent of its own will, and containing within itself an isolated, independent system of organs.

The lower portion of every cell is straight, being the continuation of the axis of the trunk, or branch of which it is a part; but the upper portion turns out of the direct line with an elbow-like bend, elevating one end above the stem. This end is free, and is surmounted by a transparent tube, which is closed by a round disc, perforated by the mouth, and bearing a crown of translucent, slender threads, called tentacles, which gracefully curve upwards like the petals of a lily (fig. 4, H). The tongue-like flap overhangs the mouth, and is continually jerked downward, instantly resuming its upright position, as if it were hinged on springs (fig. 5, I′). This is a most curious organ, and although situated outside of the mouth (fig. 5, I''), it seems to answer many of the ordinary purposes of a tongue. It evidently discriminates between the different kinds of food, but is oftener employed to close the mouth over some struggling animalcule which obstinately refuses to be swallowed. It is a fleshy semicircular prominence formed by a fold of the disc (fig. 5, I'), and is both the door of a trap, and an organ of taste combined.

The crown is interesting, not only on account of its beauty, and delicate transparency, but from the dreamy outline of each little thread, caused by the movements of the innumerable hairs investing them. The hairs, or cilia, themselves, are not visible, owing to their extreme tenuity, but the waves they make in the water can be plainly seen. So many thousands of these cilia are simultaneously moving upward on the outer sides of the threads, and downward upon their inner sides, that they force the water along in strong currents from the exterior down toward the bottom of the open-work vase where the mouth lies. The meeting of these currents coming from all sides at once, creates a whirlpool, in which hundreds of careless animalcules are continually caught and transported to the mouth. This being placed at the centre of the vortex catches all the objects entrapped by the current above, and it has, also, unfortunately for its helpless prey, a stomach beneath, which is indeed "an abyss no riches can fill." The thousands of sleepless cilia are day and night constantly in motion, drawing into the throat an endless stream of food. The stomach below is equally active, and thus all the organs work harmoniously, like machinery driven by steam, untiringly capturing and digesting the food, which, when assimilated, supplies the waste occasioned by the great activity of these parts. The threads or tentacles, also prove useful in many other ways. They can twist together with incalculable rapidity, barring out any objectionable animal which may manifest a disposition to pry into the crown; or each one can by itself bend over and eject annoying particles; or, if the throat need a little cleaning, force its way down the tube and clear it, by pushing into the stomach whatever may be clinging to the sides. They are most amusing, however, in the angry pettishness they occasionally exhibit toward intruding neighbors. First comes an admonitory push, then a harder one, if the first is not successful, and lastly, unmistakeable blows administered with vicious rapidity by many threads in unison. Sometimes a "big fish" enters the crown in the shape of an animated speck, perceptible only when magnified twenty or thirty times its own size; then the sensitive tips of the threads curve together, and imprison the coveted morsel. Caged thus in a living net, and unable to break through the bars, it is soon exhausted by the power of the miniature maelstrom, and swept, in spite of many fruitless struggles, down into the gaping mouth.

On the exterior of the tentacles, reaching about halfway up their sides, is a thin veil, looped up and hanging gracefully between them like a delicate ruffle with pointed folds (fig. 4, G). Between this veil and the dark brown cell is the pellucid tube, and through its walls we can examine the internal organs. Directly under the tongue-like projection of the disc, or epistome, is the nervous mass, which takes the place of a brain in all the Polyzoa, (fig. 5, S). It has nerves leading to the throat, the stomach and intestine, besides two branches that go to the disc, and distribute those minute nervous tendrils, which endow them with such acute sensibility. The epistome, or false tongue above the mouth, being only a fold of the disc, is hollow. The nerve-mass retreats into this cavity at will, probably by means of minute muscular fibres; and in this position, also, seeks security from injurious pressure, while the polyzoön is crowded within the shelter of its cell. Thus the epistome, in addition to its other multifarious uses, serves at times as a brain box.

The organs of digestion hang from the disc above, occupying the centre of the tube, and floating freely in the rapidly moving blood (fig. 5, K, K', K''). The throat is closed at the lower end by a valve (fig. 5, K''), which opens into a gourd-shaped sack, the stomach; close by this is another valve which opens from the stomach into the intestine (fig. 5, K''''). The last is a canal leading up, side by side with the throat, for a short distance, but finally bending away from it, and opening externally through an aperture in the pellucid tube, just below the base of the ruffle, and not far from the mouth (fig. 5, $\overline{K}$).

Though the walls of these organs are variously tinted, they are not opaque, and, therefore, while not interfering materially with the view through the clearer substance of the tube, add greatly to its beauty. The yellowish throat, the stomach striped with dark brown, and the intestine, also dark brown, form a colored axis, giving a lifelike warmth to the airy delicacy of the surrounding film.

We have seen by what strange methods the food is captured, but this is not more curious than the way in which it is digested. A throatful, for we cannot say mouthful, is no sooner admitted to the stomach, than it is rolled up and down from one end to the other, with great violence. The walls of this organ take on a circular constriction, which pursues the morsel without intermission, forcing it first to one end, and then back again to the other, from which it entered, until the particles are all crushed and reduced to a pulp. These violent convulsions also serve another purpose; they squeeze the nutritious matter, resulting from digestion, out through the membranes of the stomach into the cavity of the tube and cell, where it becomes mingled with the blood, and is carried off to give health and strength to the body.

We have spoken of the plumes being withdrawn, in one of the colonies figured, and, though it has been only casually mentioned, this habit is the greatest obstacle to the observer while endeavoring to study their form. If the table be shaken ever so lightly, every unfolded crown vanishes, and often half an hour or more elapses before continued quiet allures them forth.

All the finely proportioned, transparent parts are balanced upon a fold of the wall of the tube (fig. 5, B), which is retained in its place inside of the cell by many muscles, like fine hairs, attached by one end to the fold, and by the other to the cell wall (fig. 4, N, N′, fig. 5, N). A continuation of the fold-membrane carpets the whole interior of the cell (fig. 4, 5, E), and to it are attached, near the lower end, the muscular fibres which drag the crown and the more delicate external parts into its shelter, at the approach of danger (fig. 4, M). The muscles are arranged in great broad bands rising in two trunks, each one spreading out above into numerous smaller branches. These branches are attached to the stomach, throat and disc near the mouth, and one of them to the wall of the tube not far from the base of the veil (fig. 4, M, M′, M″). They are diaphanous, but their delicate aspect is no measure of their strength. They jerk the crown and outer tube within the cell quicker than the eye can follow them; and it is a curious fact, that after the movement is completed, and they are safely ensconced, the fibres are not content to rest, but still keep up a lively motion, writhing and twisting like bundles of minute worms.

The tentacles all the while lie gathered closely together in the sheath, formed for them by the tube, which has been doubled upon itself inside of the cell, like the finger of a glove inverted within the empty palm. When once more ready to emerge, the opening of the cell, which has been contracted by a circular band of muscle, like the mouth of a bag drawn up with a string, relaxes and permits the ends of the tentacles to protrude. These warily search for the cause of the previous alarm, and, if no hostile movements betray the presence of an enemy, the whole bundle slowly and cautiously follows, halts a moment, and then confidently unfolds its circlet of sentient threads. The Polyzoön reasons from the impression made upon these feelers, and cannot be induced to expose itself until thoroughly satisfied, by their exquisite sense of touch, that no danger lurks near its retreat.

Strange to say these plant-like creatures, singly mere animated pouches containing stomachs, show greater nervous sensibility than many more highly organized animals. They continually surprise us by actions which exhibit caution, fear, and anger to a remarkable extent, and imply a degree of complication in their relations, both social and physical, which the simplicity of the organization, and the limited sphere of its exercise render doubly interesting to the philosophical observer.

The wonders revealed in the structure of these lovely dwellers in the perennial shadows of our fresh waters, tempt one to linger, but the history of their circulatory and respiratory functions, and their curious modes of reproduction must be deferred until the next number.

EXPLANATION OF PLATE 3. *Fredericella regina* Leidy.

Fig. 1, 2, and 3. Colonies attached to pieces of bark.

Fig. 4. Magnified view of one Polyzoön. D, brown envelope, the ectocyst; E, pellucid wall of the tube and cell, the endocyst; V, funiculus; M, M′, M″, upper branches of the muscles, the retractors; N, N′, muscles of the fold, the retentors; F, a small infolding of the endocyst, the brachial collar; G, the pointed ruffle, or calyx; H, the threads, or tentacles.

Fig. 5. Outline of the interior of part of a young specimen. Same letters as above, with the exception of B, invaginated fold of the tube; Y, a very young polyzoön, a bud; K, the throat or œsophagus; H″, cilia surrounding the mouth; K‴, the valve opening into the stomach, œsophageal valve; K′, stomach; K⁗, intestinal valve partly open; K″, intestine; $\bar{K}$, opening of intestine, the anus; I, disc, the lophophore; I′, the little flap, the epistome; I″, the mouth; S, nerve-mass.

Fig. 6. Side view of the top of a cell, with the tube and crown drawn within; letters same as before with the exception of A⁗, contracted orifice of the cell; L, position of muscular band, the sphincter.

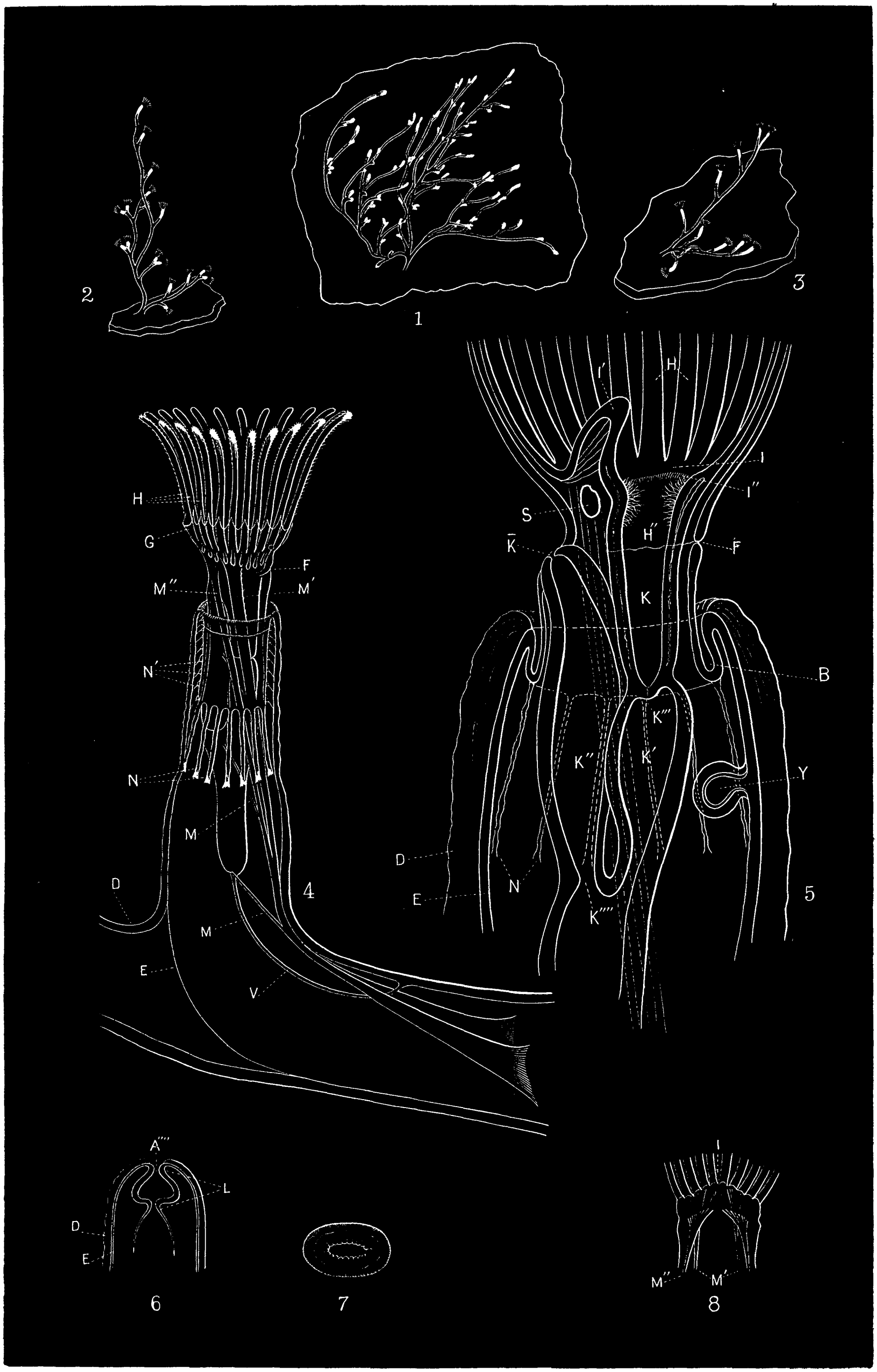
Fig. 7. View of the same from above.

Fig. 8. Front view, showing upper branches of the retractors, which are attached to the wall of the tube and to the disc, M″ and M′.

THE FERTILIZATION OF FLOWERING PLANTS.

BY J. T. ROTHROCK.

It is now universally accepted by botanists that there exist distinct sexes in the vegetable kingdom, and that nature's method of maintaining the existence of a specific form, is to bring the male and female elements in contact. In a normal flower, the first group of organs we find inside the corolla, are the stamens ; while the yellow powder, so frequently found inside of the swollen ends (anthers), is the pollen or male element. In the centre



HYATT ON THE MOSS ANIMALS.